

Pro-environmental Behavior and Generalized Trust: A Mediation Analysis

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Abstract

The previous research on generalized trust and pro-environmental behavior has built on controlling for standard demographics such as age, gender, education and income, resulting in plaguing estimates with endogeneity issues. To mitigate these issues, we extend the literature of the effects of generalized trust on pro-environmental behavior by considering four additional channels for a mediation analysis: (1) religion (2) family (3) democracy (4) and political ideology. The main analysis employs the European Social Survey, round 8 (ESS8), and considers the sub-population of environmentally concerned individuals. Using weighted-least squares, the observed hypothesized effect of generalized trust is robust to these additional channels. The chow-test reports mediation of the trust effect is driven largely by religion and religiosity. We do not establish causality for lack of an exogenous variation, but show that generalized trust is significant at the 1% level controlling for several mechanisms. Future research should rely on more robust estimation techniques to better relieve these trust equations of endogeneity issues, construct measures with more items, and incorporate a country-level analysis.

1 Introduction

Previous research on the effects of generalized trust on pro-environmental behavior has shown little efforts to mitigate the endogeneity issues (Tam and Chan, 2018; Marbuah, 2016; Nannestad, 2008). Research suggests this may have risen from fear of causally inter-related variables that plague the estimates of the variable of interest and fear from forming unrealistic models (Tam and Chan, 2018). The present paper, thus, uses the ESS8 to first reaffirm this established association between generalized trust and pro-environmental behaviour (PEB) and second, consider four additional channels backed by theory in attempts to control for confounds plaguing these trust equations.

In analyzing pro-environmental behavior, we treat climate change as a social dilemma; social because of the interactions and cooperative efforts that need to take place to address it and a dilemma because the interests of the collective are unaligned with those operating in the collective environment. There have been experiments with public good games, however, that suggest individuals *do* care about collective issues and cooperate sometimes, but they find their behavior is conditional on the other players also cooperating (e.g., Fischbacher et al., 2001; Frey and Meier, 2004; Milinski et al., 2006; Aitken et al., 2011; explanation provided by Fehr-Duda and Fehr, 2016). In the context of climate change, people who are concerned about environmental problems might be reluctant to adjust their behavior because of possible exploitation of non-participants or “*free riders*”. Thus, we suspect that having higher trust levels will mediate this reluctance to adjust behavior because of having better expectations of others that they will contribute *even without having information on these actors*. Therefore, trusting that others

will cooperate drives your own cooperation.¹

In the present research, we first test this empirically by running maximum likelihood estimations of beliefs in cooperation on generalized trust.² Findings show that being in the upper distribution of trust is associated with a greater probability of being in the upper distribution of believing others cooperate. Because the data reflects the premises, we feel comfortable moving forward that the mechanism to translate this social inefficiency into cooperation in the form of pro-environmental behavior is generalized trust. We thus postulate that *environmentally concerned individuals with greater generalized levels of trust will participate in pro-environmental behavior compared to those with lower levels of generalized trust*.

To test the hypothesis, we first recognize the copious threats to trust equations, which are: (1) endogeneity biases (2) omitted variable biases (3) and biases due to unobserved heterogeneity (Nannestad, 2008). The reason for which papers do not include additional controls may stem from fear of partialing out the trust estimate of itself through simultaneity or unrealistic modeling. When two constructs are causally inter-related, one construct will remove the true variance from the other.³ Thus, we adopt the recommendation from Spector and Brannick (2011) in selecting our controls properly. How we deal with these confounds is the value-added of the paper and thus, a verbose response is provided in Section 3. For the main analysis, we employ weighted-least squares and all estimations consider sub-populations of climate concerned individuals because non-climate-concerned individuals will free ride on pro-environmental behavior irrespective of their trust levels (Tam and Chan, 2018). Our findings show having more generalized trust in others is associated with pro-environmental behavior, surviving mediation of possible mechanisms, having estimates ranging between 7% to 13% of a one standard deviation effect on PEB, and all significant at the 1% level. Although limitations arise from how generalized trust is operationalized in our present study and how we define our dependent variable, this is a solid first step into addressing these endogeneity threats before making costly and involved decisions such as running experiments.

The paper is organized as follows. Section 2 discusses the inefficiency of climate change and justification for studying generalized trust. Section 3 reviews our data, variables and descriptive statistics. Section 4 analyzes the effect of trust on pro-environmental behavior controlling for mechanisms — demographics, family, freedom, political ideology, and religion. Section 5 discusses findings, limitations to the paper and suggestions for future research. Section 6 concludes.

2 Current inefficiency in the problem of climate change

The 2019 Europe Sustainable Development Report, henceforth ESDR (2019), reported that “*no country is on track to achieve sustainable development goals (SDGs) by 2030*”.⁴ To understand the implications of this statement: there are 17 Sustainable Development Goals (SDGs) agreed upon by all 193 U.N. member states, representing an affirmation of European values. The SDGs called on all nations to work toward economic prosperity and social inclusion in a environmentally sustainable manner.⁵ The SDGs are built into the Paris Climate Agreement, with different time horizons on when the goals are to be reached (SDGs oriented towards 2030 and the Paris Agreement oriented towards climate-neutrality by 2050). According to the ESDR (2019), it is evident that the climate change

¹Noted in expectation theory: Yamagashi (1986).

²Results and variables used may be requested. Belief in cooperation consisted in two measures: belief that others will participate in the collective action problem of climate change and the belief that enough governments will cooperate in addressing climate change.

³For example, if I included the variable for whether I believe people are fair, it is causally-inter related with trust. Moving it into the regression, there is significant evidence of partialing out. Read Spector and Brannick (2011) for more detailed information.

⁴The 2019 Europe Sustainable Development Report, VII

⁵ESDR (2019), VIII.

agenda needs to be addressed. Countries under perform on their ways to sustainable development, and the lag is critical in the domain of climate change abatement. The report continues by highlighting that “*European countries also generate large, negative spillovers that impede other countries ability to achieve the SDGs*”, further specifying that “*the largest and most pervasive negative spillovers generated by European countries are environmental*”.⁶ Given these findings, we observe that all countries fail to meet their SDGs and these failures are interdependent. This motivates our paper: under climate change, the world has not yet learned how to provide social efficiency.

2.1 Theory behind using generalized trust

The following takes a theoretical stance on the above problem and presents a mechanism to provide social efficiency. In economic paradigms, climate change is an externality. The existence of a Pareto efficient equilibrium in markets with externalities is discussed by Ronald Coase in *The Problem of Social Cost* (1960). The Noble Prize winning result of his discussions is the Coase Theorem, postulating that given low transaction costs and well-defined property rights, a Pareto efficient equilibrium in economies with externalities exists. Optimality is achieved by the virtue of Coasean bargaining between producers and consumers of the externality.⁷ However, climate change as an externality is more complex than the one presumed in the Coase Theorem. There exists no supranational authority that can manage and force everyone to commit to the common virtue of protecting the environment. Everyone emits and everyone suffers for it. This economic set-up hinders the implementation of the Coase Theorem by prohibiting access to successful bargaining between emitters and consumers of the externality. Moreover, dynamic and static models may define climate change differently⁸.

The sub-optimal outcome predicted by the theory is evidenced in the ESDR (2019). There have been attempts to restore social efficiency, however. Examples of such attempts include the UNFCCC (1992), the Kyoto Protocol (1997), and the Paris Agreement (2016). The mechanism of international agreements in restoring social efficiency lies in cooperation, in particular, the enabling of transfers (e.g., humanitarian aid or monetary transfers) as a necessary condition (Chander, 2018). Transfers are also suggested in Coase’s solution for externalities. Yet, these international agreements have not been effective.⁹ The Paris Agreement is still active, and while it does not solve the problem of climate change per se, it provides a platform for a collective effort. Having signed the Paris Agreement, member states have committed their microeconomic agents. Thus, facilitation of cooperative action among individuals can be an impactful measure to achieve social efficiency; where generalized trust is the facilitator. Taking an individual-level approach, we consider whether generalized trust can be associated with the likelihood of reducing this negative externality. We provide a game theory illustration in the appendix.

While ultimately climate change is addressed in a country-level analysis, there remains a lot of preparatory work to be done to enable this. The Classic Public Economics approach is avoidant to include an externality into the utility function of the social planner due to the difficulties related to measuring externalities in utils. A reasonable, updated structural form of the planner’s utility that accommodates an externality is needed. With the standard assumption of benevolence, the utility of the social planner represents the preferences of an average household.

Concerning households, there is also no sufficient understanding on how an externality is reflected in their preferences and thus, their utilities. We do not know the extent of a household’s utility loss due to climate change. The present paper aims to make a contribution to the research on climate change and individual preferences.

⁶ESDR (2019), p.35

⁷For theoretical results we follow Parkash Chander, *Game Theory and Climate Change*

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⁹Napoli, Christopher, *Understanding Kyoto’s failure*, for details on UNFCCC and Kyoto Protocol.

In particular, we consider whether individual behavioral preferences can be associated with the likelihood of the individual minimizing the size of a negative externality. An additional reason for the consideration: an individual level analysis lies in the reverse descending order from a country to its microeconomic agents. If a country commits to reduce climate change, it should impose the same behavior on its micro- and macro- economic agents: households, firms, and public institutions. There appears to be a concern about which behavioural preferences should be incentivised and nurtured in the population in order for climate change regulations to work. The results of our project provide a small, but expedient step on the way to climate change abatement. A natural extension of our results would be their aggregation and subsequently, a country-level analysis.

3 Data and methodology

To analyze PEB on generalized trust, we use round 8 of the European Social Survey, henceforth ESS8. The ESS8 is a cross-sectional data-set consisting of 23 countries, 44387 observations aged 15 and older, pertaining to 2016-2017 with survey measures on attitudes, beliefs, and behavior patterns.¹⁰ In particular, we focused on the rotating section containing questions concerning public attitudes and current behavior towards climate change.¹¹ The rotating section adheres to the Value-Belief-Norm framework, which defines a basis of support for social movements (e.g., in support of reducing climate change) (Stern, 1999).

Given the complex survey design of the ESS8, a multi-stage sampling approach is recognized to generate the correct standard errors to make proper inferences on the confidence intervals and p-value estimations.¹² All except one of the 23 countries in the ESS8 followed a multi-stage sampling effort.¹³ Each of the 988 non-overlapping strata spanning the data-set contain primary sampling units (PSU). The PSUs defined in each stratum form the first stage of the sampling approach, and the respondents within the PSU make up the second stage. All stages are defined geographically within countries. Thus, an individual, i , belongs to one PSU, m , one stratum, h and one country, j . All estimations consider two sub-populations of climate-concerned individuals, one for each measure of climate concern. Non-climate-concerned individuals will not participate in PEB independent of their trust levels (Tam and Chan, 2018). Estimations are ran using weighted-least squares and are clustered at the PSU level, with just over 19,000 clusters. Furthermore, several weights are implemented to correct for population size, inclusion probability, sampling errors and non-response errors, allowing for a more representative sample of each country and greater reliability of results.¹⁴

As previously mentioned, to test the hypothesis, we first recognize the copious threats to trust equations, which consist of different forms of endogeneity bias (Nannestad, 2008). First, we do not suspect reverse causality is a threat here. Although certain pro-environmental behaviors (e.g., demonstrating, partaking in clubs/organizations, surveying) may place you around people of the same beliefs and you may learn civic virtues such as trust, reciprocity and cooperation from them, Nannestad (2008) claims this should not cause generalized trust to increase and their correlation is a matter of self-selection. That the relationships they may build and learn about by practicing these kinds of pro-environmental behaviors limits trust to this private setting only. This is known as *particularized trust*

¹⁰<https://www.europeansocialsurvey.org/about/>

¹¹Documentation and information about the survey can be found here.

¹²Stas Kolenikov, 2010, pp.166

¹³The Netherlands selected to do simple random sampling; thus, all primary sampling units fell into one stratum. Read the ESS Round 8 Sample Design Data File: User Guide for further details concerning survey construction.

¹⁴Population weights were applied to correct for population size. Apart from the Netherlands, who used simple random sampling, the design weights are there to correct for unequal probabilities for selection due to the sampling design used — for example, using convenient sampling because it is cost-effective. Post-stratification weights were applied to reduce sampling error further and correct for non-response bias; made possible by using auxiliary information. Auxiliary information includes age, gender, education, and region of the respondent. More information on weights and design are here.

or private social capital. Several studies have established civic society has no causal effect on generalized trust (Uslaner and Brown, 2003; Uslaner, 2002; Claibourn and Martin, 2000; Whiteley, 1999).

Second, many papers in the literature have focused on using OLS to make inferences, without much effort to mediate omitted variable bias (Nannestad, 2008). This is a typical threat to non-experimental data, thus, we add several mechanisms that affect both generalized trust and pro-environmental behavior to see if the estimate survives. In addition, we provide Ramsey regression specification error p-values as evidence in support of correct model specification. This does not mean the model is free from omitted variables and thus, causal; but, strengthens the argument that trust is robust to these theoretical causes. This seems like a natural first step in addressing these threats before making costly and involved decisions (Spector and Brannick, 2011). For future research, we wish to use an instrumental variable for generalized trust, implement structural equations or use bayesian estimation methods.¹⁵ Lastly, to mediate unobserved heterogeneity from measurement error, all estimations are weighted to correct for non-response error and a Multitrait-MultiMethod (MTMM) 3-group design was implemented in the ESS8 for construct validity.¹⁶

3.1 Variable Definitions and Descriptive Statistics

Table 1A contains descriptive statistics on the variables to be discussed. In the following, we describe the variables and provide justification for their inclusion in the model.

Generalized Trust. This is our variable of interest. The ESS8 uses an 11-point Likert scale to measure generalized trust of an individual. To measure generalized trust, the ESS8 structured the capturing question in the following:

Using this card, generally speaking, would you say that most people can be trusted, or that you can't be too careful in dealing with people? Please tell me on a score of 0 to 10, where 0 means you can't be too careful and 10 means that most people can be trusted.

For the analysis, the variable is dichotomous, where those in the upper distribution of the Likert scale get value 1 (those who answered 7, 8, 9, 10) and 0 otherwise. Although we do lose information from disregarding the variation between trust levels in the Likert scale, the dummy-coding makes for easier interpretation and to be analogous to past estimations (Irwin, 2009. pp.182; Uslaner, 2018). Uslaner (2018), in summarizing a paper by Helliwell, Huang and Wang (2014), acknowledges this issue of comparability between the ESS (11-point scale), the World Values Survey (binary) and Gallup World Poll (binary). He suggests generalized trust from the ESS be made binary by taking the averages of generalized trust of the other two surveys and assigning 1 to categories from the upper distribution of the ESS 11-point scale until the averages are near equivalent.

We generated averages for the World Values Survey for the years 1997, 2006, and 2013 and the averages fall between 33% to 43% (unweighted). Our current strategy gives us an average of 29%. For robustness, we also run the main analysis considering the 11-point Lickert scale altogether. Results hold. To continue, Table 1 shows the

¹⁵Although structural estimation analysis would be the simplest way to mediate omitted variable bias and reduce measurement error, the ESS8 admits to having very items on a topic for structural estimation models. There has been a paper using Bayesian model averaging to analyze trust equations, but at the country level (Harvath, 2013). For the research module, we believe this is a good first step. We would like to look for exogenous variation in trust from maybe historical natural interventions or policy interventions to perform the IV analysis. More on this in Section 5.

¹⁶Other efforts on design reducing respondent errors, standardization of practices, and data processing can be found here. MTMM “is an experimental setting that consists in asking the same respondents three survey questions measuring different concepts of interest (traits) twice using different response scales (methods) each time. A MTMM experiment allows to estimate the reliability, validity and method effects of the questions included in the experiment. The product of reliability and validity is known as the measurement quality.” (ESS8 Documentation)

linear regression estimates between generalized trust, the controls and PEB. For Table 1, interpret the coefficients, defined by β , as the percent of one standard deviation (sd) change from the mean given a unit increase in the explanatory variable. For example, someone from the upper distribution of generalized trust has a 19.9% of one sd increase in PEB than someone who is on the lower distribution. Table 2 establishes the determinants of trust in this model and will be discussed through the remaining controls.

Environmental Concern. The sample is subset to individuals who are environmentally concerned. We utilize two questions to represent environmental concern.¹⁷ For the first (henceforth **Q1**), the participants in the ESS8 were given the following description of an individual: “*She/he strongly believes that people should care for nature. Looking after the environment is important to her/him*” and had to indicate their fit with the description on a 1-6 scale (1 = *Not like me at all* to 6 = *Very much like me*). We re-coded the variable to be binary, taking the value 1 if the respondent answered “*Very much like me*” or “*Like me*” and taking the value 0 if otherwise. The second question (henceforth **Q2**) is used as a robustness check as populations generated by similar questions on environmental concern should report similar effects (Tam and Chan, 2018). It asks respondents: “*How worried are you about climate change?*” and had them indicate how they felt on a 1-5 scale (1 = *Not worried at all* to 5 = *Extremely worried*). We dummy-coded this variable also to extract the group of individuals who responded *Somewhat worried*, *Very worried*, and *Extremely worried* to the question.¹⁸ This is necessary since those who do not care for the environment will not participate in pro-environmental behavior. These unconcerned individuals will free ride irrespective of their level of trust. Roughly 68.5% of the sample constitute the first group, leaving us with $\approx 29,885$ observations ($43,628 \text{ observations} \times 0.685$) in the sub-population group.¹⁹ The second group has $\approx 32,459$ observations ($42,654 \text{ observations} \times 0.761$).

TABLE 1A. DESCRIPTIVE STATISTICS

	N	mean	range		N	mean	range
<i>Variables of interest</i>				<i>Democracy</i>			
Generalized Trust	29698	0.288	0-1	Satisfaction with Democracy	28875	4.919	0-10
				Political Freedom	29287	2.045	0-4
<i>Subpopulations</i>				<i>Religion</i>			
Environmental Concern Q1	43628	0.685	0-1	Strength of religious affiliation	29506	4.66	0-10
<i>Demographics</i>				Catholicism	17791	0.544	0-1
Age	29679	48.572	15-100	Protestantism	17791	0.155	0-1
Female	29750	0.528	0-1	East Orthodox Church	17791	0.195	0-1
Categorical: Education Level	28801	2.800	0-5	Jew	17791	0.013	0-1
Deciles: Household Income	24734	5.310	1-10	Islam	17791	0.061	0-1
<i>Political Ideology</i>				<i>Family</i>			
Left to Right Scale	26224	4.901	0-10	Married	17791	0.017	0-1
				Child at home	29746	0.364	0-1

Notes: All descriptive statistics are subset to **Q1**.

Pro-Environmental Behavior. This is our outcome variable. To measure PEB, we used three items and constructed a normalized index with mean 0 and variance 1. The first item poses the following question: “*To what extent do you feel a personal responsibility to try to reduce climate change?*”. This is framed on an 11-point Likert scale (0 = *Not at all* to 10 = *A great deal*). According to the climate change report from the ESS8, this question reflects pro-environmental personal norms and serves as a prognostic to behavior, as theoretically structured in

¹⁷Suggested by Tam and Chan (2018).

¹⁸Results for **Q2** are not reported, but they are robust to the mechanisms we test.

¹⁹However, the linearized variance estimator requires the full sample in estimating the sub-population. More information on this is here.

TABLE 1. EXPLAINING PRO-ENVIRONMENTAL BEHAVIOR

<i>Explanatory Variables</i>	N	β	s.e.	t	<i>Explanatory Variables</i>	N	β	s.e.	t
Generalized Trust	27768	0.199	0.027	7.40***	Political Freedom	27457	0.153	0.015	10.14***
Age	27735	0.004	0.0008	10.05***	Political Ideology	24866	-0.032	0.006	-5.22***
Age-squared	27735	-0.0004	0.00004	-9.68***	Strength of religious affiliation	27611	0.017	0.004	3.97***
Female	27798	0.042	0.024	1.72*	Catholicism	16453	0.362	0.037	9.77***
Education	27009	0.165	0.012	13.21***	Protestantism	16453	0.337	0.029	11.55***
Income	23288	0.033	0.006	5.18***	East Orthodox Church	16453	-0.999	0.059	-16.94***
Child at home	27794	0.082	0.029	2.81***	Jew	16453	-0.124	0.076	-1.63
Satisfaction with Democracy	27150	0.034	0.005	6.51***	Islam	16453	-0.146	0.064	-2.27**

Notes: Table 1 shows the effects of each explanatory variable on PEB using weighted-least squares. We use sub-population **Q1** for these estimations. Using **Q2**, results are nearly identical in direction and magnitude except: Female loses significance, Jew becomes significant, and Islam becomes insignificant.

Stern (1999). The second item measures the respondent’s frequency in energy-reducing activities: “*In your daily life, how often do you do things to reduce your energy use?*”. It is measured on a 1-6 scale (1 = *Never* to 6 = *Always*). The last item is on an 11-point Likert scale and reads “*If you were to buy a large electrical appliance for your home, how likely is it that you would buy one of the most energy efficient ones?*” (0 = *Not at all likely* to 10 = *Extremely Likely*). According to the same ESS8 report, these last two items come from the energy-saving behaviors section; where the first item focuses on curtailment of regular behaviors and the second item focuses on people’s willingness to take efficiency by investing in new technology.²⁰

To create the index, we first standardized each item by demeaning the item and dividing it by their standard deviation. We summed the results across the three items and again divided by the standard deviation of the sum. Confirmatory factor analysis reveals uni-dimensionality of the three measures, with 1 item of eigenvalue greater than 1, and satisfies internal consistency standards (omega coefficient of 0.75). Given that these measures come from the same special subset of questions on climate change, this was expected (McDonald, R. P., 1999). A Kaiser-Meyer-Olkin test measure for sampling adequacy validates our use of factor analysis (a KMO score of 0.60 > 0.50). The design of these questions was, as mentioned earlier, a feature of the Value-Belief-Norm framework. Apart from public activism (e.g., active participation in environmental organizations and demonstrations), there are less intense ways to back a social movement and, thus, falls into one dimension of PEB (Stern, 1999). Table 1 lists the raw effects of the controls and the variable of interest on the PEB index.

3.1.1 Mechanisms

In the following, we feature the channels that could explain PEB and affect generalized trust. The channels concern the following: (1) demographics (2) family (3) freedom (4) political ideology (5) and religion. We use theory and previous research to justify their use in accordance with Spector and Brannick (2011). Table 1 reports the effects of each control on PEB. Table 2 shows the effects of these controls on generalized trust.

Demographics. In the main analysis, we control for the following individual characteristics: gender (0 = *male* and 1 = *female*), income (1 = *1st decile* to 10 = *10th decile*), age (range between 15-100), age-squared, and education-level (1 = *no formal education* to 5 = *university-level education*). Previous research has shown gender and age affect trust levels (Newton and Zmerli, 2011). As quoted by Newton: “*Women are sometimes less trusting than men, and the old sometimes more trusting than the young, but this pattern varies over time and from one country to another*” (research from Newton, 1999: 182–183; Whiteley, 1999: 34–35; quote from Newton and Zmerli,

²⁰The report can be found here. We are aware of the reaches these variables have to make versus having measures which directly measure PEB e.g., recycling, demonstrating, diet, transportation choice, etc.

2011). Table 2, rows 1 and 2 document the simple linear regression estimates of age and gender for generalized trust. Our data shows no difference in mean trust levels for age, as it is imprecisely measured ($t\text{-stat} = 0.952$), while being female is associated with being a less trusting person ($t\text{-stat} = -2.86^{***}$). To establish the use of age, income, education and female in our regression, Olli, Crendstad, and Wollebauk (2001) surveyed the effects of these demographics on PEB and considers them the standard in estimating PEB equations. Table 1, from evidence on age and age-square, shows PEB increases from young adulthood to probably middle-age and decreases over some point (indicated by the negative direction in age-squared). Table 1, row 4 shows female increasing PEB by 4% yet the result is weak.

The effect of trust might also be confounded by education. Trust is claimed to be created by education (Knack and Keefer, 1997; Knack and Zak, 2002). The social environment of an educational institution may provide you a positive outlook or at least an understanding of the spectrum of strangers. The teachings of an educational institution or medium provide the mechanisms by which enable better information processing of motivations, actions, and consequences to deflect disingenuous, defective signals (Bacharach and Gambetta, 2001; Hooghe, 2007; Newton, 2007). The counter argument is being more trusting gives you more access to help, which may help you achieve greater educational outcomes (La Porta et al., 1997; Putnam, 2000). We decided to leave education as a control for our estimations. Table 2 shows more education is associated with greater trust ($t\text{-stat} = 15.01^{***}$). Table 1 shows the same pattern for PEB ($t\text{-stat} = 13.21^{***}$). Being educated has already been shown to cause a wide range of pro-environmental behaviors (Meyer, 2015). On income, many papers have already established the positive link between income and trust levels (Alesina and La Ferrara, 2000; Brehm and Rahn, 1997; Putnam, 2000). Those with higher incomes have been materially successful, have the means to protect themselves from risks and are supported by institutions; they might also be surrounded by more trustworthy people. For our data, Table 2, row 4 shows a strong positive effect of income on generalized trust ($t\text{-stat} = 10.07^{***}$). Table 1 again follows the same direction ($t\text{-stat} = 5.18^{***}$).

Family. Previous research has found that having a child increases the level of trust and other social measures (Mason, 2010). Mason (2010) focused on community design, seeking factors that increase social capital by looking at mechanisms that reduce isolation — having a child being the mechanism that reduces isolation amongst people and fosters growth in social capital. Looking at the effect of having a child at home on generalized trust, our data generated the opposite result (Table 2, row 5): having a child is correlated with being less trusting ($t\text{-stat} = -2.28^{**}$). Not sure if there is a fear dimension flipping the direction of the variable; having a child may make a parent more cautious, and they may internalize this in their trust levels. In terms of having children and PEB, as a parent, we suspect you may internalize your child’s future and, thus, may participate in reducing the impact on climate change. Table 1 shows having a child is associated with greater PEB ($t\text{-stat} = 2.81^{***}$).

Freedom. To trust, you must be free to do so. Greater economic freedom, political freedom, and a strong legal system is associated with greater trust levels (Berggren and Jordahl, 2006), yet having a developed democracy is associated with wealth, and this could be driving the effect on trust as well. The greater trust levels come from insurance: having a strong legal system minimizes the impact of mistrusting someone. From our data, we are unable to measure legal quality. Instead, we use two measures of democracy to capture freedom. First, participants of the ESS8 were asked how satisfied they were with how democracy works in their country. Second, they were asked if they agreed, with the following statement: “Political system allows people to have an influence on politics”. These two variables are supposed to represent democratic strength and freedom. Influencing politics is associated with having a developed democracy and thus, a strong legal system (O’Donnell, 2004). We suspect that if democracy works well, and legal systems is this insuring mechanism, then trust levels should increase. Both operating on an

TABLE 2. EFFECTS ON GENERALIZED TRUST

Variable of Interest ← Mechanism	β	s.e.	t-stat	Variable of Interest ← Mechanism	β	s.e.	t-stat
Demographics				Political Ideology			
Generalized Trust ← Age	-0.00002	0.0003	0.952	Generalized Trust ← Political Ideology	-0.012	0.002	-5.89***
Generalized Trust ← Female	-0.027	0.009	-2.86***				
Generalized Trust ← Education	0.068	0.005	15.01***	Religion			
Generalized Trust ← Income	0.0205	0.002	10.07***	Generalized Trust ← Strength of religious affiliation	-0.004	0.002	-2.86***
Family				Generalized Trust ← Catholicism	-0.040	0.013	-3.07***
Generalized Trust ← Child at home	-0.022	0.01	-2.28**	Generalized Trust ← Protestantism	0.159	0.012	13.17***
Freedom				Generalized Trust ← East Orthodox Church	-0.097	0.023	-4.17***
Generalized Trust ← Satisfaction with Democracy	0.038	0.002	20.12***	Generalized Trust ← Jew	0.108	0.026	4.22***
Generalized Trust ← Political Freedom	0.088	0.005	17.85***	Generalized Trust ← Islam	-0.048	0.032	-1.49

Notes: Table 2 lists channels for Generalized Trust and their marginal effects. All estimations use maximum likelihood and are weighted to correct for population size, non-random sampling, non-response bias and other sampling errors. The unit of observation is an environmentally-concerned individual of one of the 23 countries in the sub-population **Q1**. For **Q2**, results hold. For Table 2 only: Education, Income, Satisfaction with Democracy, Political Freedom, Political Ideology and strength of religious affiliation is taken as an average effect versus showing effects for each category within each variable.

11-point Likert scale, Table 2 shows satisfaction with democracy and political freedom having robust effects on trust ($t\text{-stat} = 20.12^{***}, 17.85^{***}$). In terms of democracy and freedom on PEB, the literature is expansive. Hadler and Haller (2011), given the literature on social movement theory and political structure theory, empirically test whether seasoned democracies have effects on pro-environmental behavior in the public and private spheres and results are in support of their hypothesis. Table 1 also shows strong positive effects for the variables on PEB ($t\text{-stat} = 6.51^{***}, 10.14^{***}$).

Political Ideology. Left-wing ideologies tend toward redistribution of wealth and income equality, which already has been countlessly associated with greater levels of generalized trust (Bjørnskov, 2006). Furthermore, they typically foster solidarity and use that to push their policies. Nevertheless, the *very* left carry rhetoric centered on the rich being the antagonist and exploiting the poor, which might make you less trusting of these affluent individuals. Papers such as Beck et al. (2001) and Bjørnskov (2006) create a variable with three categories: left, center, and right. Although it does address the problem of ideology and trust, it removes variation and loses information. There is a reason someone chose 3 vs. 4 on the political spectrum. Thus, we control for each point in the political spectrum, operationalized on an 11-point Likert scale (0= *left* to 10=*right*). Table 2 shows a strong negative effect as expected ($t\text{-stat} = -5.89^{***}$). Left-wing ideologies are typically associated with favoring green policies, environmental attitudes and environmental behaviors. A fair-share of papers have been written establishing this fact across time (e.g., Guber, 2013; Neumayer, 2004; Dunlap, 1975). Table 1 shows left leaning ideologies tend toward pro-environmental behavior ($t\text{-stat} = -5.22^{***}$).

Religion. One of the more persistent and defining features of a society is its religion. There have been papers on religiosity (a quantification of religion), its effects on pro-social behavior, and to whom they exhibit this pro-social behavior (Irwin and Berigan, 2013; Stavrova and Siegers, 2013; Ahmed, 2009; Preston and Ritter, 2013). Our data seconds this association (Table 1: Strength of religious affiliation, $t\text{-stat} = 3.97^{***}$). Although religion is associated with living with certain principles, fostering altruism, virtuosity, and helpfulness, controlling for how religious someone is ignores between-group differences and the essence of ethnicity associated with that religion.²¹ To capture that, we control for different religions: Catholicism, Protestantism, Orthodoxy, Jewish people, and Islam (Irwin and Berigan, 2013).

Research shows strong negative effects of hierarchical religions on trust: Catholicism, Orthodox Christianity, and Islam (La Porta et al., 1997; Berggren and Jordahl, 2006).²² In our data, the variation is significant for only

²¹See Smith (1978) on a primer of religion and ethnicity.

²²Hierarchical religions – Catholicism, Orthodox Christianity and Islam – have religious traditions that promote cultural attitudes

Catholicism and Orthodoxy, but the directions are in accordance (Table 2, $t\text{-stat} = -3.07^{***}$, Orthodoxy $t\text{-stat} = -4.17^{***}$ and Islam $t\text{-stat} = -1.49$). Concerning Protestantism, Uslaner (2002) finds a positive effect on trust. The reasoning for this result is a consequence of the above: hierarchical religious structures come with social distance. The success of Protestantism is explained in the following:

“Protestantism might reect an even deeper source of trust, as Ekelund et al. (2002) show that the success of there formation in certain European societies crucially depended on a relatively high degree of social mobility already existing at the time, which reduced the possibilities of the Catholic church to act as a discriminating monopolist (in selling salvation). As such, part of the effect of Protestantism might simply be an extremely long-run effect of reduced social distance.” (Bjørnskov, 2006).

In par with the research, the data shows a positive effect on trust from being Protestant ($t\text{-stat} = 13.17^{***}$, Table 2, religion section). Table 1 also shows Protestantism having effects on PEB ($t\text{-stat} = 11.55^{***}$). Lastly, Jewish people are above average in terms of trust levels, as it is built into Jewish tradition to treat strangers as they would themselves (Uslaner, 2008). Table 2 is representative of this fact ($t\text{-stat}$ for Jew = 4.22^{***}). Of the controls, religion carries the greatest raw effect on PEB and trust. For PEB, all religions have an effect greater than 12% of a sd, with the highest being 99% (East Orthodox Church). These estimates were also quite large for the estimations in Table 2 (See the religion section).

To confirm its viability as a control, 1980s and 1990s research finds negative relationships with respect to religiosity and environmental activism, possibly stemming from religion being incompatible with the environmental paradigm (Hand and Van Liere, 1984; Dunlap and Van Liere, 1983). In 2007, in an attempt to reconcile these findings, Sherkat and Eillison (2007) take a structural approach and recognize the variation between religions, not just religiosity. In his survey of papers, he points out scientific studies on religion suggest Abrahamic religions besides the branches of Christianity (e.g., Islam and Judaism) may be antagonistic toward nature. The literature on this and the reasoning’s contained are vast and arguably exhaustive, so we do not wish to dwell. In sum, Catholicism and Protestantism should signal positive pro-environmental behaviors, while Islam and Jew should signal negative pro-environmental behaviors. Concerning the Orthodoxy, Greeley (1993) has argued the negative influence is spurious, that it is merely a reflection of the political conservatism. Guth et al.’s (1995) paper contends it is religious conservatism that motivates political conservatism; thus, religious factors are believed to be indirectly causal rather than spurious. As mentioned above, the directions of the point estimates are in par with the literature (Table 1, bottom rows). I pay special attention to this channel as I make the main analysis.

3.2 Econometric Framework

The econometric model for the main analysis considers the sub-population of those concerned for the environment and estimates the relationship between generalized trust and PEB.

$$PEB_{imhj} = \beta_0 + \beta_{1imhj} \times Generalized\ Trust + \beta_j + X\beta_{imhj} + \varepsilon_{imhj} \quad (1)$$

PEB is the outcome variable for climate-concerned individual, i , belonging to PSU, m , and strata, h , from country, j . *Generalized Trust* is as explained above. β_j is the country fixed-effects.²³ β_{imhj} is a vector of the coefficients of the individual characteristics, \mathbf{X} . ε_{imhj} is a heteroskedasticity-robust error term. Equation 1 is

associated with respect for social hierarchy and official authority. Therefore, believers in hierarchical religions tend to be obedient to authority. More on this from Ko and Moon (2014).

²³For the model, we use country fixed effects to capture unobserved heterogeneity in institutions, culture, history, and behavior between countries. Using regional fixed effects, compiled of a mix of NUTS level 1, 2, and 3, does not affect results nor estimates.

modeled using weighted-least squares, with clustered standard errors at the PSU level.

4 Empirical Analysis

Table 4 shows the main results for **Q1**. Since the index has mean 0 and variance 1, estimates are interpreted as the percentage change of 1 sd about the dependent variable given a unit increase in the independent variable. A greater value for the index represents more pro-environmental behavior. Further, we include several channels to see if they capture some variation and mediate the effect of trust. To measure the mediation, we show chow-test p-value results, comparing all trust estimates to the respective base control model, Column (1). Lastly, for Column (1) and (7), the table also includes a regression specification-error test (RESET) result for evidence of omitted variable bias for a certain class of variables, where the null is “*model has no omitted variables*” (Ramsey, 1969). This class of variables are the second, third and fourth powers of the predicted values for the model. This is done for the respective columns to see evidence of correct model specification.

In all, the results are robust when controlling for each mechanism and all mechanisms. Consider sub-population **Q1** for the moment.²⁴ Controlling for unobserved heterogeneity between countries, the trusting effect increases environmentally concerned individuals PEB by 13.2%*** of one sd (significant at the 1% level). Column (2) considers country fixed effects and demographics: age, age-squared, female, categorical education, income deciles. The trusting effect improved PEB by 12.7%*** of a sd. Column (3) controls for the religion dimension: strength of religious affiliation, whether you are Catholic, Protestant, East Orthodox, Jewish or Muslim. When controlling for this mechanism, the estimate is mediated. An increase of 8.4%*** of one sd in PEB is shown given a unit increase in generalized trust. Thus, part of the variation between generalized trust and PEB is driven by this channel.

Column (4) controls for a family mechanism: having a child at home. The channel is associated with a 4% decrease ($((\frac{0.127-0.132}{0.132}) = -0.039)$ in the point estimate compared to Column (1). The difference is marginally significant (*chow-test p-value* = 0.075*). Column (5) shows evidence of a second mediating factor. Conditional on demographics, democracy and political freedom, having greater generalized trust increases PEB by 11.3%*** of one sd. The estimate drops 14% when compared to Column (1). The chow-test reveals the difference is insignificant (*p-val* = 0.247). In Column (6), conditional on demographics and political ideology, being in the upper distribution of generalized trust is associated with a 11.9% of one sd increase in PEB. Lastly, Column (7) puts all mechanisms in the model, country fixed effects, and demographics of the individuals. The point estimate of trust is slightly more than half of that of Column (1) (46% drop). The chow-test shows mediation from these channels on the trust estimate is significant at 5% significance level. Also, the RESET p-val shows evidence of correct model specification (*RESET p-val* = 0.272). This is reported as a minimum threshold that the model is free from misspecification.²⁵ A linktest of the full model (as described earlier) shows the predicted values to be significant (*t-stat* = 20.61***) and the quadratic predicted values term to be insignificant (*t-stat* = -0.99); indicating evidence of linearity in the model and correct model specification. For the final column, conditional on the all controls, the estimate shows a 7.1% of one sd increase in PEB from being in the upper distribution of generalized trust.

Column (7) of the main results for **Q1** is tested to see whether OLS is the optimal estimator and if inferences can be made. First, to test for (1) linearity between PEB and the predicted values, a linktest is performed to see if any link functions (e.g., age^2) are necessary. **Q1** passes the linktest as previously mentioned. An extension of the linktest is the RESET test, which tests for significance of different powers of the fitted values (i.e., \hat{PEB}^3 , and

²⁴Results are also available for **Q2** upon request. In sum, results hold fully for **Q2**.

²⁵More on this can be found in *Applied statistics using Stata: a guide for the social sciences* by Mehmet Mehmetoglu and Tor Georg Jakobsen

TABLE 4. PRO-ENVIRONMENTAL BEHAVIOR ON TRUST

<i>Pro-Environmental Behavior</i>	% of Standard Deviation						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Generalized Trust	0.132***	0.127***	0.084***	0.127***	0.113***	0.119***	0.071***
Q1	(0.021)	(0.023)	(0.025)	(0.023)	(0.022)	(0.022)	(0.026)
Country f.e.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Demographics		Yes	Yes	Yes	Yes	Yes	Yes
Religion			Yes				
Family				Yes			
Democracy					Yes		
Political Ideology						Yes	
All Mechanisms							Yes
chow test p-val	—	0.724	0.027**	0.713	0.247	0.446	0.010**
RESET p-val	0.760						0.272
Mean dep. var.	0.187	0.223	0.231	0.223	0.244	0.269	0.286
Observations	41575	36355	26532	36353	35739	34434	25104
R^2	0.211	0.260	0.283	0.260	0.260	0.253	0.280

Notes: All regressions are estimated using Ordinary Least Squares and are weighted to correct for population size, non-random sampling, non-response bias and other sampling errors. The unit of observation is an environmentally-concerned individual of one of the 23 countries in the data-set from years 2016-2017. Pro-Environmental Behavior is an index formed by three items discussed in Section 3. Estimates are interpreted as the percentage change of 1 s.d about the dependent variable given a unit increase in the independent variable. Generalized Trust is 1 for individuals who answered 8, 9, or 10 on the generalized trust 11-point Likert scale, 0 otherwise. Base Control is country fixed effects. Demographics are age, age-squared, household income deciles, categorical education, and male. Religion contains five binary controls for: Catholicism, Protestantism, Judaism, Islam, Orthodoxy and strength of their affiliation. Family contains 1 binary variable: Child at home is 1 if the unit of observation has a child at home. Democracy contains two scale controls: satisfaction with democracy and political freedom. Political ideology controls for each factor in the 10-point political spectrum. All Mechanisms control for country fixed effects, Demographics, Religion, Child at home, Democracy, and Political Ideology. chow test p-val measures the mediation effect by comparing column estimates to Column (1). RESET p-val is a significance test for fitted powers of the predicted values. Linearized robust estimation is used for the standard errors (s.e.) of the estimate and appear in the parenthesis. S.E.s are clustered at the level of the primary sampling unit. Observations is the full sample observation versus the sub-population because of the nature of the calculation. *** means significant at the 1% level, ** means significant at the 5% level, * means marginally significant at the 10% level.

$P\hat{E}B^4$). The result, as shown in Table 4, is insignificant; providing more evidence for linearity. For robustness, visual inspection of a residuals-versus-predicted values plot is also made and we do not suspect evidence of non-linearities. Second, to test for (2) full-rank of the matrix of regressors, we use a variance inflation function (vif) to catch multi-collinearity. Column (7) does not raise concerns of multi-collinearity, reporting a mean vif result of 3.88.²⁶ Literature finds imprecision arising from such scores to be inconsequential (Hair et al., 1995; Menard, 1995; Neter et al., 1989). Third, there is no need to test for (3) homoskedasticity since we use robust standard errors. Nevertheless, visual inspection of the residuals-versus-predicted values plots do not show the residuals to be a function of the regressors. To test for (4) exogeneity, our mediation efforts come from the theory and previous research backing the relationships between variables versus trying statistical methodologies (as recommended by Spector and Brannick, 2013). For proper inferences, we test for the additional assumption of (5) normality of the errors by visually inspecting two plots: a standardized normal probability plot (P-P) and a plot of the quantiles of the residuals and the quantiles of the normal distribution (Q-Q). The first plot detects irregularities in the middle of the distribution; the second plot catches irregularities in the tails (Miller, 1997). The P-P plot shows light deviation in the middle of the distribution and the Q-Q plot shows light deviation in the tails, but the plots do not raise any cause for concern. Lastly, (6) independence of the errors is violated since we are clustering errors at the PSU level, but the 19,000 clusters themselves are independent and recognized as clusters in our model. In conclusion, our model satisfies the assumptions to retrieve the best linear unbiased estimator from using OLS.

5 Discussion

5.1 Findings

The impacts of generalized trust have traditionally been measured using OLS without much mediation of omitted variable bias. To address this issue, this paper has shown four additional mechanisms backed by theory and previous research to see if the effects of trust on PEB survive at the individual level: (1) family (2) freedom (3) political ideology (4) and religion. Using weighted least squares, the paper shows the observed hypothesized effect of generalized trust being robust to these additional channels for the two sub-populations. Climate-concerned individuals on the greater distribution of generalized trust elicit more PEB. The trust estimate is mostly mediated by the religion channel, yet remained robust at the 1% level. We do not establish a causal relationship, however, because we lack some exogenous variation in trust and thus, our trust estimates may still be confounded by other mechanisms. As said by Putnam (2000): *“the causal arrows among civic involvement, reciprocity, honesty, and social trust are as tangled as well tossed spaghetti”*. This, thus, warrants caution with model specification. The inter-correlations between trust and other covariates can generate misleading, imprecise and biased trust estimates. For the future, we plan to pursue an instrumental variable analysis using some exogenous variation or structural equation modeling/bayesian model averaging to see the causal relationships between the variables. The present setting is not apropos for policy implications.

5.2 Limitations and suggestions for future research

A notable challenge to the paper is of generalized trust and the hard-to-measure nature of this construct. For the present paper, our definition of trust adopts a measure which is commonly used in the literature and was designed

²⁶These values report how much higher the variance of β_i is compared to the baseline of uncorrelated regressors. A threshold of 5 or 10 is seen as the max allowable vif. The closer to 1, the better. Nevertheless, terms such as age and age-squared will always have high vif results. Likewise, so will categorical variables. Thus, given our estimation is made up fully of categorical variables, this vif result is strong. Yet, vif results are non-important in establishing significance nor direction, only magnitude.

by Rosenberg (1956) in its initial form as part of a “faith-in-people” Guttman scale²⁷: “Some people say that most people can be trusted. Others say you can’t be too careful in your dealings with people. How do you feel about it?”. Since then this question, with some modifications of the wording, has been used by survey institutions, in particular, by the General Social Survey (henceforth, the GSS). That said, there is a growing body of research challenging the status-quo of the measure of generalized trust. The GSS question on generalized trust is as follows “*Generally speaking, would you say that most people can be trusted or that you can’t be too careful in dealing with people?*”. This question is identical to the one used in the ESS. The concern is whether this generally accepted trust measure indeed reflects and predicts trusting behaviors. The potential problem with this measure of trust is that its design is attitude based and does not capture records of past trusting behaviours. This is important because a slightly different outlook on the measure can lead to a reinterpretation of our results.

To discuss the validity of this measure and how it might affect our paper, we rely on experimental evidence obtained by Glaeser et al. (2000). In their paper, the authors investigate whether the survey attitudinal question as posed by the GSS on generalized trust indeed has the power to predict trusting behaviours. The main finding is that the responses to the GSS trust question do not predict trusting behavior on a significant level, but that the question significantly predicts own *trustworthiness* of the respondent. Moreover, the questions on recorded behaviours (i.e., “*Have you ever lent X money*” did significantly predict trust of the students in the games.²⁸ In the case that these experimental results are valid and the GSS question is a good measure of trustworthiness, but not trust, then we have to conceptually redesign our model. In this new light, our hypothesis would be that more *trustworthy* individuals are more pro-environmental as opposed to saying that more trusting people behave more pro-environmental. As you can see the definition of trust has sizeable implications.

Based on the above discussion, one simple way to improve our paper is to add another measure of trust. In place of the GSS/ESS question on generalized trust, we can construct an index which captures past trusting behaviours. With a better definition of trust, we can feel about our predictions. In addition, the ESS8 does not contain many items on pro-environmental behavior to perform proper factor analysis. We believe that given the restrictions of our dataset, we constructed the best PEB index possible and that it performs well in capturing the multitude of climate change related behaviours. For the future, it is recommended to use other datasets ample in PEB measures to define a better construct. We also suggest conducting an experiment to validate the results. First, climate change related behaviours are not difficult to observe, thus a fairly precise experimental estimate should be feasible to researchers. While the difficulty to estimate and define trust remains, we believe it is possible to come up with a high-quality experimental design of a climate change game. Second, the nature of the climate change agenda requires practical implementation of policies.²⁹ Taking this into account, we recommend conducting experimental studies before implementing any green policies.

Lastly, the setting of the analysis should be multi-level. Climate change is addressed by countries. Of course, a unit of positive or negative impact comes from the individual, but, countries negotiate, sign contracts, participate in agreements and so forth. The ESS8 does not have enough variation to make such an analysis with only 23 countries. Therefore, it is important to make an analysis on the aggregation of individual trusting behaviours with as many countries as possible.

²⁷Robbins, Blaine. (2019). Measuring Generalized Trust: Two New Approaches. 10.2139/ssrn.3212109.

²⁸These results might be statistically imprecise: the small sample size, large standard errors on the GSS trust question, and the design of the games ought to be considered.

²⁹Similarly, P. Chander in *Game Theory and Climate Change* asserts policy making as the ultimate goal of the book: “*The book indeed approaches policy considerations to the extent that an actual policy can be enlightened by theory or a policy recommendation can be derived from theory*”. Running developed policies in experimental mode and estimating their effects are important stages prior to scaling it up

6 Conclusion

Our findings reveal the complexity of both trust equations and climate change. Although mediation efforts by controlling for theoretically backed channels of generalized trust revealed robustness of the trust estimate, it cannot be taken as a reliable estimate still because the estimate may still be driven by other mechanisms unconsidered. An exogenous variation of trust relieves this one issue, but future analysis must also consider the measure of trust and its reliability in measuring an individuals generalized trust in others.

7 Appendix

7.1 Game theory illustration

7.1.1 Strategic implications

Let the present section take a game theoretic setting of the analysis. We model a simple strategic set-up of our problem to illustrate the social inefficiency of climate change while accommodating the our controls. We create the following set-up:

Two roommates live next to a foul trash bin which results in bad air quality in their rooms. Each roommate is a teenage student financially supported by the government and their parents. In this way, neither of them needs to take care of paying for basic life necessities such as water, electricity, education, rent, etc. Each student has two free hours per week that can be spent on doing two things. The student can babysit and earn some money where the money is immediately on a consumption good — ice-cream. In the payoff matrix, this option is labeled as “ice-cream”. As the second option, the student can clean the foul trash bin and enjoy fresh air in the room. This is labeled as “Clean”. Cleaning the trash bin takes effort. The trash bin can be perfectly cleaned with high effort of a single student or by joint moderate efforts of both. If at least one of them chooses to clean, we assume the trash bin is perfectly cleaned that week.

Both students enjoy fresh air. In fact, the outcome with highest payoffs to both players corresponds to the strategies profile, B (clean, clean). Both students enjoy ice-cream, but to a lesser degree than fresh air. One would be happiest if they consume both fresh air and ice-cream, but being a free-rider here offsets the pleasure from ice-cream and fresh air because of the proximity of living to the other person. Free riding diminishes utilities of both students.

	Ice-cream	Clean
Ice-cream	$(1^*, 1^*)_A$	$(0.5, 0)$
Clean	$(0, 0.5)$	$(2^*, 2^*)_B$

As seen from this simple game, there are two Nash equilibria, denoted by A and B, with B being Pareto dominant. To achieve social efficiency in the room, the students will need to engage in some form of bargaining. It is reasonable to expect that trust as well as the four additional channels, namely, family background, views on politics, democracy, and religion can play a determining role in the likelihood of the roommates achieving a mutually beneficial bargain — the Pareto dominant equilibrium, B.³⁰

Explanation for the design of the game is the following: two players are roommates because we needed two people who live close enough to share common environment and breathe the same air, but don't need to have common values like a family would have. This means chosen strategy profiles are due to exogenous factors.

³⁰According to P.Chander, Pareto efficient equilibria with climate change are cooperative equilibria.

We assume both care about the air quality they are exposed to, because our empirical analysis is restricted to individuals who are environmentally concerned. Therefore, their utilities are not just about consumption, but also the externality. The condition on receiving financial support was made to give the students freedom in strategy choices. The strategy of babysitting and buying ice-cream reflects the forgone strategy if one pursues a pro-environmental action. As such, when one chooses to clean, the student does not sacrifice an option of pursuing a life essential. Lastly, the game is a one-shot game with complete information because it is the most convenient structure to convey the main strategic and behavioural implications of our empirical analysis. A more realistic way to model the game would be to make it a Bayesian repeated/dynamic game, but we would need to have a better idea about the structural form of the utility function to generate the expected utility values.

7.2 Cooperation and efficiency

The above simple game theoretic setting can explain why cooperation is a requirement to solve the climate change problem. This subsection highlights the theoretical proof by P. Chander in that cooperation is needed to achieve Pareto efficiency. To achieve global efficiency, no country should pollute beyond the point where the marginal benefit of further production equates the environmental damage it incurs and secondly, each country should reduce climate change up to the point where the marginal cost of forgone production is equal to the marginal benefit of abating climate change. The first important implication that makes cooperative Pareto optimal equilibrium differ from the sub-optimal non-cooperative equilibrium is that an efficient allocation (x^*1, \dots, x^*n, z^*) can only be generated by an emission profile (e^*1, \dots, e^*n) .³¹ This second efficiency implication states that marginal abatement costs of forgone production across all countries have to be equalized. P. Chander further elaborates that is that all efficient profiles (x^*1, \dots, x^*n, z^*) can only be generated by the unique emission profile (e^*1, \dots, e^*n) , i.e. with climate change efficiency can only be achieved if all countries release emissions in accordance with the same emission profile (e^*1, \dots, e^*n) and efficient allocations (x^*1, \dots, x^*n, z^*) differ from one another only in terms of the consumption goods. The problem is, however, that countries are different and with enough variation in the costs and gains from following (e^*1, \dots, e^*n) there must be at least one player for whom switching from non-cooperative profile (x_i, z) with corresponding (e_i) to (x_i^*, z^*) and respectively (e^*i) results in a loss of utility, such country has no incentive to change its non-cooperative strategy. This suggests that transfers of a consumption good as a form of cooperation among countries could be a tool needed on the way to social efficiency.

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³¹ z^* is the damage function. P. Chander, *Game Theory and Climate Change*, proposition 3.1.

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